

# Biosecurity Plan

## MARAMEC SPRING HATCHERY

2009



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## Introduction

Maramec Spring Hatchery is located approximately six miles southeast of St. James. The hatchery is located within Maramec Spring Park which is owned by the James Foundation (also known as TJF). It totals 1,850 acres in sections 1, 2 and 12, T37N, R6W in Phelps County and sections 6 and 7, T37N, R5W in Crawford County. Maramec Spring Park is Missouri's fourth trout park, and the hatchery was constructed to raise stocking size trout for the park.

Maramec Spring Hatchery is a rear-out facility that obtains 120,000, 3-inch rainbow trout fingerlings annually from Shepherd of the Hills Hatchery. All fish raised in the hatchery are stocked on site. Constructed in 1964, the hatchery consists of a 436-foot serial raceway and a round pool. The raceway is 12' wide and can be divided into four separate pools. Pool 1 is 120'L x 12'W x 2.42'D. Pool 2 is 107'L x 12'W x 2.42'D. Pool 3 is 107'L x 12'W x 2.42'D, and Pool 4 is 102'L x 12'W x 2.42'D. The average flow rate per unit is 1,400 gallons per minute (gpm) with an exchange rate of approximately 3.22 times per hour. The round pool is 10,344 cubic feet with a flow rate of 1,500 gpm and an exchange rate of 1.16 times per hour.

The water supply for all rearing units is obtained from the Maramec Spring pool which is a man-made impoundment of Maramec Spring. Maramec Spring is Missouri's fifth largest spring with an average daily flow of 96 million gallons per day (mgd) and a peak flow of 420 mgd. Water enters the raceway through a 24" culvert located in the spring pool. The culvert is shallow in the spring pool and has limited grating. The flow is between 2.4 cubic feet per second (cfs) and 3.1 cfs. The round pool receives water from the spring pool through steel grating at a rate of 3.33 cfs. The bulk of the spring's water exits the spring pool via a rip-rap dam. As the spring flow rises and falls, the water level in the spring pool must be adjusted with a water control structure that is also a foot bridge (Figure1).

The first pool in the raceway is used for the youngest fingerlings in the system. Sixty-thousand, 3-inch fingerlings are loaded into Pool 1 in late March/early April. These fish are moved into Pool 2 in May as a second lot of 60,000, 3-inch fingerling arrive into pool one. As the fingerlings grow, they are inventoried and split into two pools as soon as they obtain 6 inches of growth. In August, the largest fish are moved to the round pool where they will finish growing to 12 inches. The other 60,000 fish remain in the raceway until stocked. An additional 15,000, 6 to 8-inch fish are raised in the raceway in late fall. Maramec Spring Hatchery cannot supply all of its rainbow trout needs. The deficit of 55,000 rainbow trout is received from Montauk Hatchery as 12-inch stockers.

The hatchery is also used as a transfer station for 6,000 brown trout that are stocked annually into the Meramec River Red Ribbon Trout Area. This is a nine-mile stretch of the Meramec that starts at the Highway 8 bridge just above the park and terminates at Scott's Ford access. The brown trout are distributed in this section annually in April over a five-day period.

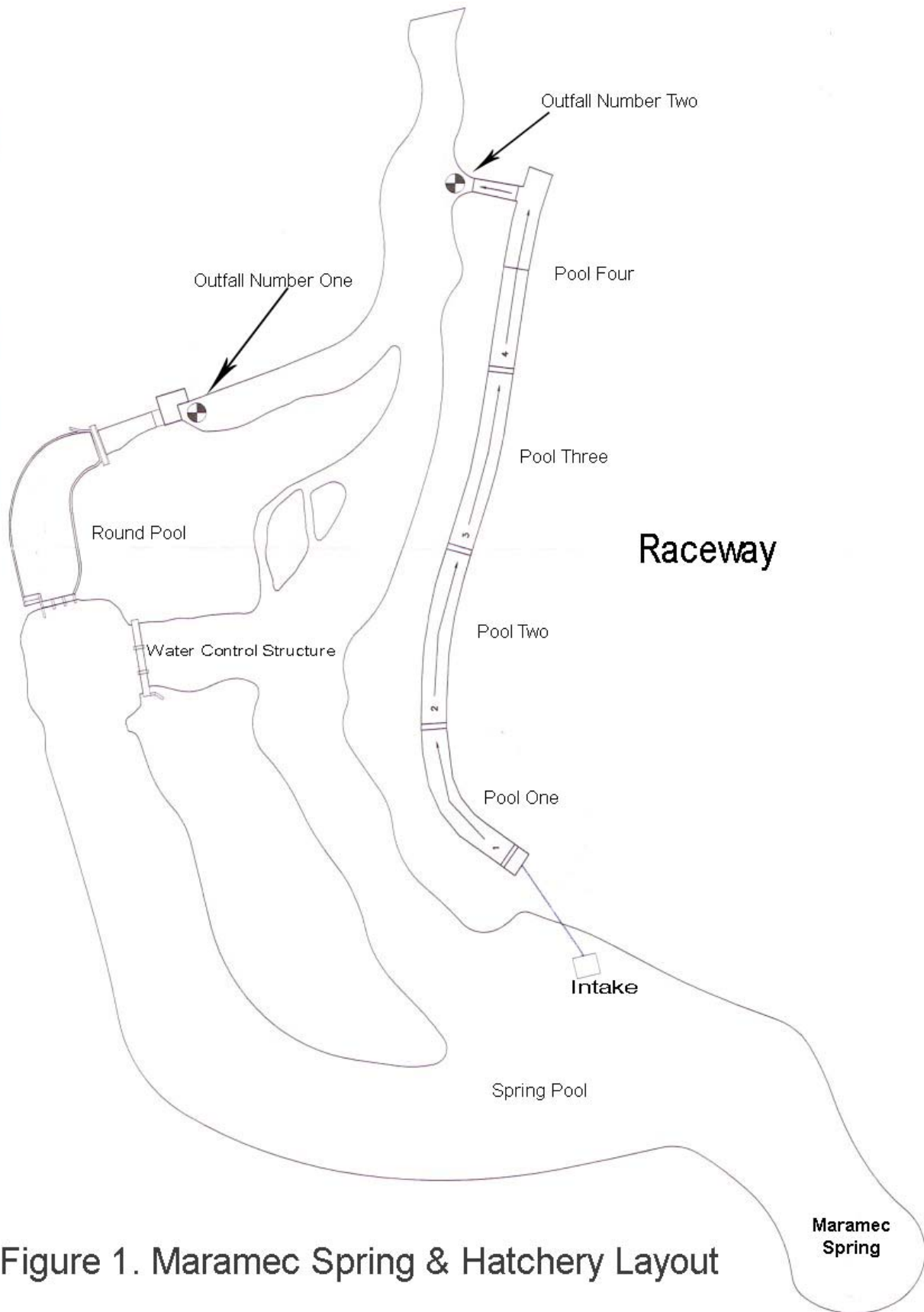


Figure 1. Maramec Spring & Hatchery Layout

This plan will serve as a guide to contain biosecurity hazards that are currently present and prevent new ones from occurring.

### **Limitations**

This plan may be constrained by The James Foundation. It is the wish of the James Foundation to keep the Maramec Spring basin as close to its present condition as possible. As a result, efforts to maximize the health of fish raised at this facility are compromised. The following protocol shall be used in negotiations and relationships with The James Foundation:

1. Continually keep the James Foundation informed of fish health and biosecurity concerns at the park.
2. New technology and practices should be thoroughly explained to TJF and every effort should be made to keep the facility as non-intrusive as possible.
3. Any new agreement between MDC and TJF shall include a section on fish health concerns and hatchery improvements.

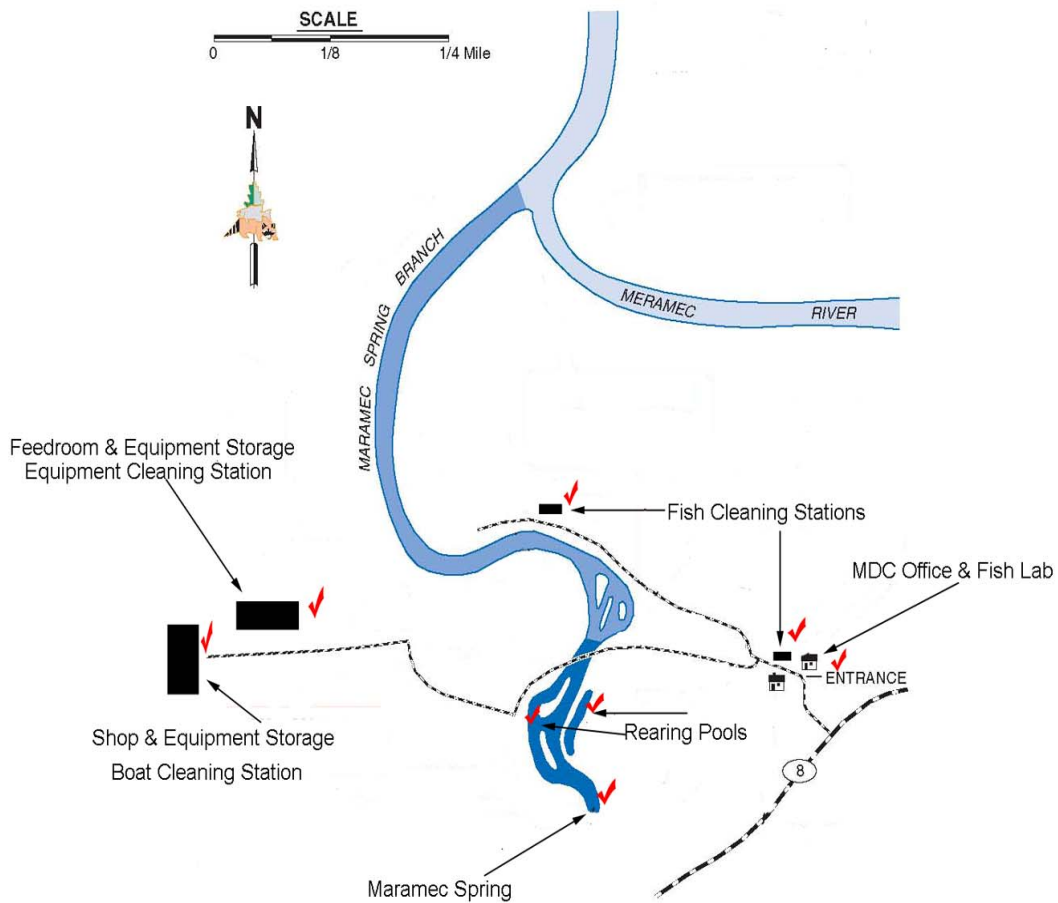
### **Copepods at Maramec Spring Hatchery**

Maramec Spring pool, the pool where waters from the spring emerge, holds a considerable number of trout which are infected with parasitic copepods (*Salmincola californiensis*) (Figure 2). This parasite attaches to the inside of the mouth, the gills and lining of the opercle (Figure 3). It primarily infects the larger size fish and causes low levels of mortality through damage to the gills and increasing the susceptibility of these fish to other pathogens. Parasites on fish from the spring pool routinely infect new fish brought into the hatchery since the water from this pool flows directly into the rearing units.

The copepods are believed to have originated from the old Fishermen's Dude Ranch near Steelville, Missouri and infected the Meramec River in 1990. Attempts to eradicate fish from the spring pool have been unsuccessful due to the volume of water present in the spring. It is assumed that copepods are now inherently present in the Maramec Spring and Meramec River drainage system. Therefore, only Maramec Spring Branch and Meramec River are stocked with fish from the Maramec Spring Hatchery. Staff will not take any special precautions when stocking these waters.

The greatest threat is transfer of this parasite to another hatchery in the system. The following protocol will be used to contain the copepod threat to Maramec Spring Hatchery:

## Maramec Spring Hatchery and Trout Park



**Figure 2**



**Known Bio-Hazard Area**



Figure 3. Parasitic copepods in the mouth and gills of rainbow trout at Maramec Spring hatchery.

1. No species of trout will be transferred out of the hatchery to another facility under any circumstance.
2. In the event that a lot of fish must be removed for any reason and cannot be stocked in the spring branch or Meramec River, they will be destroyed.
3. Any fish handling or aquatic equipment that is borrowed by another hatchery or used in the water supply will be disinfected and dried out before use.
4. Any truck delivering fish to Maramec Hatchery will use their own nets and piping.
5. In the event that the drug emamectin benzoate is approved by the FDA for an INAD, the hatchery will participate in the study.

## General Equipment Use and Cleaning

**Background:** A variety of equipment is used at Maramec Spring Hatchery. Equipment and human hands are recognized as modes for pathogen transfer. Viruses, bacteria and parasites are invisible to the naked eye so their transmission via objects goes easily unnoticed. Examples of common equipment items are listed below.

Personal protective equipment: e.g., waders, hip boots, rubber boots, raingear, gloves.

Work equipment: e.g., dip nets, buckets, brooms, brushes, sponges, towels, feed blowers, aerators, water pumps, weighing scales.

Vehicle equipment: e.g., fish trucks, ATV, golf carts, pick-up trucks, boats, fish loading

pumps, boom trucks and fork lift.

## **Highest Risks**

Pathogens: bacterial, viral, parasitic and aquatic nuisance species.

## **General Guidelines**

1. The sharing of personal protective and work equipment between fish hatcheries is discouraged. Guest workers at fish hatcheries should be provided personal protective equipment to use during their visit. This equipment shall stay at this site. If on the rare occasion that there is not enough equipment available for guests and they must bring their own, these items should be thoroughly disinfected before and after use on-site.
2. Specific sites shall be designated on hatchery grounds where equipment and protective clothing will be cleaned or disinfected (Figure 2).
3. During cleaning the layers of fish slime, mud or organic debris will be removed first through brushing, hosing or power washing, then they shall be soaked or sprayed with disinfectant.
4. Porous materials, such as wooden handles on dip nets, shall be eliminated and replaced with non-porous materials such as fiberglass or metal. If sponges or cloth towels are used, they shall be clean, changed daily, or disinfected after each use.
5. Virkon® Aquatic is the disinfectant of choice because it is the only disinfectant approved for aquaculture use.
6. The potency of reconstituted disinfectants shall be tested at least once every 4 days with test strips. If it has evaporated or the active ingredient level is less than the recommended strength, it shall be refreshed or replaced with new disinfectant.

## **Vehicle Disinfection**

1. If fish transport trucks are sent off-site to deliver or move fish they will be power washed and disinfected either en-route back to the hatchery or at the designated cleaning site on the hatchery grounds (Figure 2). They shall not be used for any additional loads unless they are disinfected. Proper disinfection shall include power washing followed by Virkon® Aquatic 0.5% sprayed inside the holding tank, on nets and through hoses. External surfaces may be further cleaned with 200 ppm chlorine bleach. After disinfection, all equipment will be rinsed with clean water.

2. Vehicles used to transport dead fish from raceways to the mort pit area shall be hosed out at the designated equipment cleaning area at least once weekly and disinfected. More frequent cleaning will be warranted if mortalities are high or there is spillage from buckets on to the bed of the vehicle.

## **Fish Transfers**

**Background:** Fish are stocked into public waters, received from non-MDC hatcheries, captured from the wild, moved between MDC hatcheries and moved within individual hatcheries as they grow and have changing space requirements. Pathogen transfer may occur during all of these activities.

### **Highest Risks**

Aquatic nuisance species and pathogens (parasitic, bacterial, viral).

### **Transfers from non-MDC hatcheries**

1. Before a shipment of Salmonid fish shall be received from a non-MDC fish hatchery, the shipper shall submit a current fish health inspection record for review and issuance of an import permit (if necessary).
2. In addition to inspection of this report, the hatchery manager shall ask the hatchery manager or other shipper to complete and return via FAX or email a "Fish Transfer Information Sheet" (Appendix: Attachment 1) along with mortality records for the previous 15 days. This sheet will help us identify in writing any other pathogens/nuisance species not specified on the health inspection record which may occur in their watershed or hatchery. This would include things like other viruses, parasites, zebra mussels, New Zealand mud snails, quagga mussels, rusty crayfish or parasitic copepods.
3. If fish are received, they shall be "quarantined" into Pool 4 (Figure 1) for 4 weeks and observed daily for signs of disease.
4. All equipment used during the off-loading of these fish shall be immediately disinfected after use.

### **Transfer of fish between MDC hatcheries**

1. Fish will only be received at Maramec Spring Hatchery. Three (3) days prior to the transfer of fish between MDC hatcheries, the shipping facility shall FAX or email to the Maramec Spring hatchery manager, a copy of the sending unit's mortality record which shall cover the previous 15 days. In addition, comments shall be made regarding the lot's general history, past chemical therapies and notes of any abnormal behaviors observed by completing a "Fish Transfer



Information Sheet" (Appendix; Attachment 1).

2. The Maramec Spring Hatchery stocking truck will be disinfected before moving incoming fingerlings.
3. Fish will be off-loaded into Pool 4 when receiving fish into the raceway. When possible, this raceway will be an "isolation" unit where the fish can be monitored for and treated for post-transport disease outbreaks for at least 4 weeks before they are co-mingled with other resident fish.
4. Post-transportation stress in the fish may be reduced by providing 0.1- 0.5% salt for 1-3 days after arrival.
5. In the event that Maramec Spring Hatchery trucks are used to haul fish at another facility, the transport truck shall be power washed and disinfected either en-route back to the hatchery or at the designated hatchery cleaning site. It shall not be used for any additional loads unless it is disinfected.

An ideal **quarantine area** is "an isolated space separate from resident fish with dedicated equipment and supplies, limited foot-traffic and managed personnel and traffic flow". <http://www.flisart.org/PPT/AQU-EMQ-PPT-2007-01.ppt> retrieved 9/28/08

## Treating Sick Fish

**Background:** When disease outbreaks occur in a rearing unit the risk of spreading this pathogen to other rearing units increases. Our goal is to isolate this "sick" unit as much as possible.

### Highest Risk

Spreading pathogens to other rearing units on-site.

### General Guidelines

1. The cause of the increased mortality shall be identified through necropsy, skin scrape, gill biopsy, clinical signs, bacterial or viral culture. It shall then be treated appropriately.
2. Units of sick fish will be considered as "quarantine areas" and specific equipment shall be dedicated for their use only. This equipment will be disinfected and stay at that site.
3. All equipment coming in contact with these fish and unit shall be immediately disinfected with 0.5-1% Virkon® Aquatic .

4. A minimum number of people shall work with these fish.
5. After any contact with these fish or water (e.g., picking up mortalities, brushing raceway) staff shall wash hands with soap and water or use a hand sanitizer.

## **General Sanitation**

**Background:** The maintenance of a high standard of general sanitation is a proven method for minimizing disease outbreaks in both human and veterinary practices. At Maramec Spring Hatchery, the following has been identified for general sanitation: (1) handling of fish mortalities from rearing units; (2) cleaning of rearing units between lots; and (3) cleaning of counters and floors in the fish lab.

### **Highest Risks**

Bacterial pathogens in dead fish are at peak levels; therefore their handling can be considered a serious mode of disease transmission. Parasites and bacterial pathogens may be transmitted in water and/or fish waste products. Bacterial and viral pathogens may contaminate hands, floors and equipment in laboratory areas where sick fish are necropsied.

### **Fish Mortality Sanitation**

1. A disinfection station will be located at the feed room/storage building (see Figure 2). All equipment will be in the storage room of this building.
2. Specific equipment (e.g., nets, buckets) shall be designated for picking up dead fish. Buckets and nets used for this activity will be prominently labeled and not be used for any other activity.
3. A large bucket containing Virkon® Aquatic at 1-2% will be available for soaking nets between uses. Ideally, while a net is being used another one can be soaking for at least 5 (2%) -10 (1%) minutes before it is used again.
4. A second pan filled with Virkon® 1% to a depth of 1 to 2 inches shall be placed in the vehicle. The mort bucket will be placed in this pan during use to minimize contamination of the vehicle.
5. Mortalities will be removed daily from rearing units.
6. Mortalities shall be taken to the James Foundation's designated area for burial. This area is located away from the immediate park. Some mortality will be frozen for use as food for captive wildlife or may be transported off-site

- to the state tree nursery for land application (as appropriate by permit).
7. Personnel shall wash their hands with soap and water or use hand sanitizer after collecting and disposing dead fish. Hand sanitizers shall be conveniently placed in vehicles and be available in the office.
  8. The vehicle used to transport the dead fish shall be hosed out at the designated equipment cleaning area at least once weekly and disinfected. More frequent cleaning will be warranted if mortalities are high or there is spillage from buckets on to the bed of the vehicle.

### **Fish Handling and Aquatic Equipment use**

1. Use of wooden live boxes will be discontinued and replaced with aluminum boxes.
2. Aluminum live boxes shall be disinfected before reuse and anytime a box is moved from raceways to the round pool.
3. Truck and boat washing station will be located at the MDC shop (Figure 2).

### **Cleaning Rearing Units**

1. Raceway units shall be brushed once a week.
2. Once a year, a power washer shall be used to remove organics from the sides and bottoms of the raceways.

### **Fish Lab**

1. When sick fish are brought into the lab for necropsy, the following measures shall be taken to reduce contamination since both infected water and fluids often find their way to floors and counters.
2. At the completion of work in the lab, the counters and floor will be sprayed or mopped with 500 ppm chlorine bleach (sodium hypochlorite) or 0.5% Virkon® Aquatic spray.
3. For routine laboratory cleaning and disinfecting of floors, 0.5% Virkon® Aquatic is recommended. Lower level, less corrosive disinfectants such as Roccal or Hyamin (quaternary ammonium compounds) or Lysol (phenol compound) are satisfactory.

### For desired sodium (Na) hypochlorite solution

$$\frac{(\text{ppm Na hypochlorite desired}) (\text{gal of water}) (128)}{\% \text{ of active Na hypochlorite } (10,000)} = \text{ounces of household bleach needed}$$

e.g. 
$$\frac{(500 \text{ ppm}) (1 \text{ gal}) (128)}{5.25\% (10,000)} = 1.2 \text{ ounces of } 5.25\% \text{ household bleach needed per gallon of water}$$

4. Spent scalpel blades, needles and microscope slides used during evaluations will be disposed of in a "sharps container". Plastic loops used for bacterial cultures will be disposed in a heavy-duty plastic container. Sharps and loop containers will be disinfected with 1 part bleach and 9 parts water for at least 1 hour prior to disposal in general trash.

## Fish Cleaning Stations

**Background:** There are two fish cleaning stations located in the park (Figure 2). These stations are currently operated by the James Foundation. Offal from cleaning fish caught in the park is collected in barrels and disposed of by the James Foundation on their property across the road from the park. Mortalities from the pools are placed into the barrels for disposal. Current TJF practice is to spread fish offal on the ground to decay.

### Highest Risks

Parasites and bacterial pathogens may be transmitted in water and/or fish waste products. Bacterial and viral pathogens may contaminate hands, vehicles and equipment. Wildlife consuming offal could spread disease.

1. Fish cleaning stations should be disinfected daily with 500 ppm sodium hypochlorite.
2. An attempt to find an offsite disposal area for mortality from the hatchery will be made.

## **Weed Cutting Boat**

**Background:** There are currently two, 12-foot boats that are used in streams to control aquatic vegetation at four trout parks (Montauk, Maramec Spring, Roaring River and Bennett Spring). In addition, these boats are used to control vegetation at Stone Mill, a trout area near Fort Leonard Wood. These boats are available statewide, and at times have been used in impoundments. At the trout parks, these waterways supply water used to rear fish in the adjacent fish culture facility.

### **Highest Risks**

Zebra mussels, nuisance aquatic plants, parasitic copepods and unknown pathogens carried in water.

### **General Guidelines**

1. Start with clean dry boat.
2. After boat use, follow general cleaning protocol established for "Zebra Mussel Prevention" (Appendix; Attachment 3) with the following recommendation: from among the possible disinfection methods indicated for controlling zebra mussels, hot water power washing (>140° F for >10 sec or >176 F for >5 sec) or chlorine disinfection at 200 ppm then air drying (3-5 days) between uses at trout parks is recommended.
3. All personal equipment (waders, rain gear, rubber boots, gloves, etc.) exposed to stream water shall be sprayed with Virkon® Aquatic using a 0.5% solution before they are used again in hatchery waters.
4. Boat trailers will be modified to remove carpeted padding and wooden boards.

## **Public Use**

**Background:** Each year 300,000 people visit Maramec Spring Hatchery/Park and purchase an average of 58,000 tags to fish in the park. They come from all over the world. Currently, the public is welcome to freely explore areas around our outdoor raceways, and guided tours are provided of the rearing areas. MDC encourages educational interaction with the public at all fish hatcheries. Wildlife frequenting Maramec Spring Hatchery includes great blue herons, bald eagles, skunks, raccoons, otters, muskrats, possums and various waterfowl. Wildlife not only prey upon fish but can also transfer diseased fish from one area to another and regurgitate partially eaten food. They are recognized as biological vectors of disease.

## **Highest Risks**

### **Humans**

1. Although the risk is ranked as low, footwear and hands of visitors may transfer undesirable pathogens, parasites or aquatic nuisance species (e.g. whirling disease spores, zebra mussels) onto facilities (muddy shoes) or between rearing units (if hands are put in the water).
2. Trash or rocks thrown in water may be consumed by fish who mistake it for food.
3. Visitors have been known to arrive with aquarium fish to release in the spring pool. Several instances of goldfish releases have happened.
4. Minnows are allowed in fishing areas.

### **Wildlife**

1. Mechanical transfer of diseased fish or aquatic nuisance species.

### **General Guidelines-Humans**

1. Public traffic around outdoor rearing areas is unavoidable.
2. Employees will have to be present and visible around pools to observe the public. If needed, the public will be reminded verbally of rules.
3. With the concurrence of TJF, information concerning disease transfer risks of aquarium releases and bait dumping shall be posted on a sign in the reception area and near the spring.

### **General Guidelines-Wildlife**

The following steps may be undertaken to discourage nuisance wildlife residence at Maramec Spring Hatchery.

1. Mortality disposal areas will be off hatchery area.
2. Dead fish will be removed from rearing units every eight hours.
3. Nuisance animals will be controlled with use of traps and bird depredation permits.
4. Feed storage areas will be kept clean and tidy.

# General Disease and Aquatic Nuisance Species Surveillance

**Background:** Implementation of a surveillance program will provide a means of detecting the presence of aquatic nuisance species and pathogens for early intervention and help provide bench marks for eradication measures.

## Highest Risks

1. Viral pathogens: VHS, IPN, IHN.
2. Parasites: whirling disease, parasitic copepods (*Salmincola californiensis*), Ich, trematodes, *Trichodina*, *Costia*, *Chilodonella*, *Epistylis*.
3. Bacteria: *Aeromonas salmonicida*, *Yersinia ruckeri*, *Flavobacterium psychrophilum*, *Flavobacterium columnare*, *Aeromonas spp.*, *Pseudomonas spp.*, *Renibacterium salmoninarum*, *Flavobacterium branchiophilum*.
4. Aquatic nuisance species: zebra mussel, New Zealand mud snails, Quagga mussels, etc.

## General Guidelines

1. Good staff education is the number one preventive measure for disease surveillance.
  - a. Education will provide a means for staff to recognize problems and take steps to correct them.
  - b. Recommend that each staff member take the Basic Fish Health class provided by MDC.
  - c. If there is interest, the MDC Aquatic Animal Health Specialist will be available to provide additional on-site training or refreshing of fish diagnostic techniques.
2. The MDC Aquatic Animal Health Specialist will conduct annual testing for viruses (IPN, IHN, VHS), whirling disease, parasitic copepods, BKD, enteric redmouth, and furunculosis at all MDC fish hatcheries.
  - a. Fish displaying abnormal behaviors (going off feed, changes to skin color, reddened fins, increased mortalities, etc.) will be promptly evaluated (at a minimum, by general external appearance, skin scrape and gill biopsy) on-site and treated appropriately. If initial therapy is unsuccessful or if additional tests are needed which are not available

(e.g. bacterial culture, histopathology) they will be referred to the MDC Aquatic Animal Health Specialist for further evaluation.

- b. Mortality records in writing will be maintained on a daily basis for each rearing unit.

## **Budget Considerations**

The hatchery will need to have a supply of Virkon® on hand. Aluminum boxes, screens and equipment will need to replace wooden equipment. A hot water power washer should be purchased to facilitate the cleaning and disinfection of equipment and raceways. Low head oxygenators could be added to better maintain fish health.

## **Summary**

The two most important aspects to this plan are the threat of copepod infestation spreading to another hatchery via poor management practices and an apparent lack of understanding and concern for fish health and biosecurity by The James Foundation. Another important aspect is acceptance from on-site MDC employees of following this plan and its protocols. It will be imperative for the staff to be fully trained in biosecurity protocols and accountable to hatchery management staff. The threat of a copepod infestation spreading to the other hatcheries is virtually a zero risk if the protocols listed in this plan are followed. Educating TJF staff on the importance of biosecurity and fish health and upgrading to the latest hatchery technologies (e.g., LHOs) will be priorities if we are to maintain fish health in this facility. We will also need to work with TJF staff to address the continued practice of land applying fish offal; it is potentially a water pollution problem and a definite draw for nuisance wildlife. The current agreement between the Missouri Department of Conservation (MDC) and TJF should be modified so that all these concerns can be negotiated in a formal agreement.



**APPENDIX** Attachment 1.

**Fish Transfer Information Sheet**  
(Submit via email at least 3 days prior to shipment)

Today's date: \_\_\_\_\_

Anticipated shipment date: \_\_\_\_\_

From: ☐ Bennett ☐ Maramec ☐ Montauk ☐ Roaring River ☐ Shepherd ☐ Other: \_\_\_\_\_

To: ☐ Bennett ☐ Maramec ☐ Montauk ☐ Roaring River ☐ Shepherd ☐ Other: \_\_\_\_\_

Lot Designation: \_\_\_\_\_ From Raceway/Unit: \_\_\_\_\_

**Lot History**

Mortality record for last 15 days provided (see page 2)? ☐ Yes ☐ No

Fish taken off feed 3 days prior to shipment? ☐ Yes ☐ No

The following aquatic nuisance species occur in this hatchery's watershed:

☐ Zebra mussels ☐ Parasitic copepods ☐ Rusty crayfish ☐ Quagga mussels

☐ New Zealand mud snails ☐ Other: \_\_\_\_\_

General Health within last 30 days: ☐ Excellent ☐ Good ☐ Fair ☐ Poor

(Basis of this classification: ☐ Mortality records ☐ Observation/feed intake ☐ Necropsy: gills, skin, organs)

If fair or poor: what problems were observed or suspected? \_\_\_\_\_

Any chronic problems? \_\_\_\_\_

Therapeutics used in last 30 days:

Therapeutic Used	Yes √	Date Treated	Why treated?	Results or Comments (cured problem; partial, little or no improvement)
None	<input type="checkbox"/>			
Aquaflor	<input type="checkbox"/>			
Chloramine-T	<input type="checkbox"/>			
Copper sulfate	<input type="checkbox"/>			
Formalin	<input type="checkbox"/>			
Immersion OTC	<input type="checkbox"/>			
MS-222	<input type="checkbox"/>			
Oxytetracycline	<input type="checkbox"/>			
Perox-Aid	<input type="checkbox"/>			
Romet	<input type="checkbox"/>			
Salt	<input type="checkbox"/>			
Vinegar	<input type="checkbox"/>			

## Mortality Record Previous 15 days

[illegible]

Attachment 2. Disinfectants and chemotherapuetics for aquaculture.

Products	Use/supplier	Contact Time/product	Cost
<b>General Methods</b>			
Hot water-power wash	General cleaning		
Steam clean	General cleaning	5 minutes	
<b>Chemicals</b>			
750 ppm KCl, 25 ppm Formalin	Zebra mussel prevention	KCl-1 hr, then add formalin-2 hrs = total time of 3 hrs	
Virkon® Aquatic	Western Chemical		10 lb tub= \$92 10 lb (4)=\$328
0.5%	General use, clothing, inside hauling tanks, equip., vehicles	10-30 min.	
1.0%	Foot bath	10 min.	replenish/check q 4 days
2%	Vaccination equipment	5 min.-then rinse with water	
Argentyne, Ovadine®	Egg disinfection	30 min-water hardening; 10 min. after water hardening (eyed eggs)	1 gallon Ovadine® \$25.95
50-100 ppm Sodium hypochlorite (household bleach)	General cleaning	corrosive to metal, toxic to fish unless detoxified with sodium thiosulfate	
200 ppm	vehicles	1 hour	
500 ppm	laboratory-counters/floors	10 min-1 hour	
Sodium thiosulfate	detoxify chlorine	grams thiosulfate= 2.85 x grams chlorine used	
<b>Monitoring supplies</b>			
Chlorine test strips	HACH	0-600 mg/l Cl <sub>2</sub> #2890200	q=100 \$17.40
	Fisher	0-200 ppm #22-479-808	q=200 \$5.15
Iodine test strips	Fisher	0-100 ppm #22-307-863	q=200 \$5.15
Virkon® S test strip	Western Chemical-Antec International	see <a href="http://www.wchemical.com">www.wchemical.com</a>	\$6.95, also provided free with each case of Virkon

## **ZEBRA MUSSEL PREVENTION**

### **POLICY**

*The Missouri Department of Conservation will work to prevent the spread of zebra mussels from infested waters to uninfested waters.*

est. 10/05

### **PROCEDURES**

#### **• RESOURCE THREAT**

Zebra mussels can clog power plants, industrial and public drinking water intakes, foul boat hulls, decimate populations of freshwater mussels and other native aquatic organisms, impact fisheries and disrupt aquatic ecosystem functions. Economic impacts of zebra mussels in North America are estimated to be in the billions of dollars.

Because of the ease with which microscopic larval zebra mussels may be transported by the public, it may take several years to detect an infestation. Avoiding known infested areas, or staging equipment use such that waters known, or suspected to be infested, are visited last, will help prevent the spread of zebra mussels. However, boats, equipment, and gear must be decontaminated prior to use in different waters. Personnel will take reasonable precautions to avoid exposure of equipment, facilities, and other waters to zebra mussels.

#### **• PUBLIC OUTREACH AND EDUCATION**

Increased public outreach and education will enhance understanding of the potential problems associated with zebra mussels and the measures that may help deter their expansion. Signs should be posted at all MDC owned and managed boat ramps highlighting the potential problems associated with zebra mussels. Information should be distributed through our state, federal and non-governmental agency partners, MDC managed waterfowl areas, trapping associates, sport fishing groups, marinas, lake associations, Department offices and Nature Centers, media outlets and to other water users in Missouri.

#### **• EQUIPMENT DECONTAMINATION PROCEDURES**

Appropriate safeguards to prevent the transfer of zebra mussels from one waterbody to another are mandatory and include inspection, treatment, and, if possible, avoidance.

The following steps detail equipment decontamination procedures:

1. Thoroughly inspect boats (hulls, drive units, trim plates, transducers), trailers and components (rollers, bunk boards, axles, etc.), equipment (i.e., water pumps, hatchery equipment, siphons, nets, ropes, traps, etc.), and machinery (tractors, bulldozers, etc.) for adult zebra mussels. Pay close attention to nooks, crannies and other inconspicuous places (i.e., around the motor housing, trim tabs, and water intake screens, or pump fittings). All trash, mud, vegetation, and suspected zebra mussels should be removed and properly disposed of in the trash. Immediately report suspected occurrences of zebra mussels to the Invasive Species Coordinator.
2. Carpeted bunks and runners on existing boat trailers should be replaced with poly,

plastic or wooden bunks as soon as practical; boat trailers regularly moved between known zebra mussel infested waters and other waters should have carpeted bunks and runners replaced immediately. As available, future boat trailers should be purchased with poly/plastic/wooden bunks.

3. All water should be drained from boats, trailers, motors, live wells, bilges, transom wells, holding tanks and live wells, water pumps, pipes, and other equipment prior to leaving a waterway. Pay particular attention to boat hulls under installed decking. Drain as much water as possible from equipment such as lower motor units and portable pumps.
4. Any boat, trailer, tank, equipment, machinery, gear, or net transferred from one body of water into a different body of water or from known infested waters to potentially infested waters must be decontaminated using one of the treatments in Table 1 prior to being used in a new body of water. Equipment decontamination procedures should be completed when moving equipment from infested areas of a water body to uninfested areas of the same water body. If boats, nets, and other equipment are only used in one body of water, cleaning between uses is not necessary, but these boats, nets, and other equipment **MUST** be clearly labeled for use in that body of water **ONLY**. Periodic cleaning and decontamination (i.e., during winterization or other maintenance) should be conducted to prevent costly repairs. If management or research activities require this equipment to be moved in the future, decontamination procedures will be implemented.

## ● HATCHERY PRECAUTIONS

Best management practices should be used to protect equipment and facilities and to reduce the opportunity for the spread of zebra mussels to uninfested areas.

Introductions of zebra mussels into MDC fish hatcheries or water supply sources would have devastating impacts upon hatchery infrastructure. If infested, hatcheries would then be a possible mechanism for transporting the organisms to uninfested waters.

Therefore, the following precautionary measures will be enacted by MDC fish hatcheries:

1. All attempts will be made to secure fish from sources known to be free of zebra mussels (veligers and adults) (see map at <http://intranet/Documents/17407.pdf>)
2. All fish and eggs exposed to surface water coming into or leaving any of MDC's hatcheries or other facilities and any fish procured through contract or other means from outside sources must be treated during transportation using one of the treatments in Table 3. The only exception will be for fish that are stocked into the same water supply that is used by the hatchery (e.g., trout stocked in Bennett Spring branch by Bennett Spring Hatchery staff) and for selected species of conservation concern.

3. Specific limitations may be applied to native mussel and hellbender culture, and other species of conservation concern, on a case-by-case basis.
4. Some species or life stages of fish or other aquatic organisms may be less tolerant of chemical treatments. For these species or life stages whose chemical tolerances are unknown, bioassays must be performed prior to large scale use of the prescribed treatments listed below. Until these bioassays are conducted, brood stock of these species will only be obtained from waters known to be free of zebra mussels.

Table 1. Zebra Mussel Disinfectants and Usage Guidelines for Boats and Equipment			
Disinfectant	Concentration	Contact Time	Usage Guidelines, Safety Precautions, Drawbacks
Vinegar	100%	20 min	Use appropriate personal protective equipment (PPE) and caution. Stay upwind of the spray. Is corrosive to metal and toxic to fish at this concentration, so thoroughly rinse with tap water or water from the next lake or river after disinfection. Ensure that solution does not run-off directly into waterways.
Chlorine	200 ppm	10 min	Use appropriate PPE and caution. Stay upwind of the spray. Is corrosive to metal and rubber and toxic to fish at this concentration, so neutralize with 800 ppm sodium thiosulfate and rinse thoroughly with tap water or water from the next lake or river. Ensure that solution does not run-off directly into waterways.
Power wash with hot water	>104° F	20 min	Use appropriate PPE and caution when using hot water due to possibility of burns/scalding. Temperature and contact times are crucial, as efficiency is weather dependent. Most effective when used in conjunction with air drying (see below). Power wash with hot water, including thoroughly flushing lower motor unit.
Freezing	<32° F	24 hrs	Boats, gear, and equipment should be thoroughly frozen. Ambient air temperature should remain below freezing for the entire contact time. No safety precautions.
Air drying	N/A	3-5 days in hot sun 48 hrs in hot sun	Must dry completely to be effective. Most effective when used in conjunction with hot water (see above). To be used for small nets, gear, pumps, etc., <i>ONLY AFTER</i> power washing with hot (104°) water for appropriate contact time.

Salt Bath	1%	24 hrs	Due to the long contact time, may only be used as a bath solution and not sprayed. To be used only for pieces of equipment, gear, and nets that can be completely immersed in the solution.
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Table 2. Disinfectant Amounts to Make Needed Concentrations					
Disinfectant	1 gallon	2 gallons	5 gallons	20 gallons	100 gallons
100% Vinegar	1 gal	2 gal	5 gal	20 gal	100 gal
200 ppm Chlorine (household bleach, 5.25% Chlorine)	0.5 ounce (15 ml)	1.0 ounce (30 ml)	2.5 ounces (75 ml)	11.0 ounces (300 ml)	6 1/3 cups (1.5 L)
200 ppm Chlorine (HTH granular)	0.04 ounce (1.2 g)	0.08 ounce (2.4 g)	0.2 ounce (6 g)	0.8 ounce (24 g)	4.2 ounces (120 g)
800 ppm Sodium Thiosulfate	0.1 ounce (3 g)	0.2 ounce (6 g)	0.5 ounce (15 g)	2.1 ounces (60 g)	10.6 ounces (300 g)
1% Salt Bath (as NaCl)	1/8 cup	1/4 cup	2/3 cup	2 2/3 cups	13 1/3 cups

Notes:

1. Air drying and hot water are most effective when used in conjunction with each other because their effectiveness is highly dependent upon ambient temperatures and contact times. As needed, hot water wash units should be made available at selected Department facilities.
2. Household bleach (5.25% chlorine) and vinegar can be purchased from grocery or convenience stores. HTH granular chlorine (70% calcium hypochlorite) and Sodium Thiosulfate can be purchased at pool supply stores or chemical companies.
3. All bilges and hidden areas under boat decks must be thoroughly treated as described above.
4. Source: WI DNR (2007) *Equipment Disinfection Protocol for Invasive Species and Viruses*.

Table 3. Hatchery/Fish/Aquatic Organism Zebra Mussel Treatments and Usage Guidelines			
Treatment	Concentration	Contact Time	Usage Guidelines/Comments
NaCl	20,000 ppm	2 hrs	Used for striped bass only. Treatment conducted during transport.
KCl/formalin	750 ppm KCl 25 ppm formalin	1 hr 2 hrs	Used for all other fish species and eggs. Fish and hauling water are pretreated for 1 hour with 750 ppm KCl, followed by a 2 hour treatment with 25 ppm formalin during transport. <i>DO NOT</i> treat fish with NaCl to counteract shock, as this decreases the effectiveness of the treatment.

Notes:

1. All fish, including those used in aquaria at nature centers, fairs, etc., are to be treated for zebra mussels while in transit.
2. Treatment concentrations and contact times that are currently exceeded during normal aquaculture operations (e.g., egg hardening and shipping) should be considered effective.
3. Some species or life stages of fish or other aquatic organisms may be less tolerant of chemical treatments. For these species or life stages whose chemical tolerances are unknown, bioassays must be performed prior to large scale use of the treatments listed above.
4. For species with known intolerances to recommended zebra mussel treatments, modifications of hatchery assignments, increased use of well water, UV treatment, sand filtration, and other system modifications or treatment/avoidance measures may be needed and should be considered on a case-by-case basis with the involvement and approval of Division Chiefs and the Invasive Species Coordinator.
5. Sources: IA DNR *Fairport Fish Hatchery ANS-HACCP*, Edwards *et al.* 2000.